Highly automated and time-resolved BioSAXS at the P12 beamline of EMBL Hamburg

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The last decades saw a sharp increase in the use of small angle X-ray scattering (SAXS) for the characterisation of biological macromolecules in solution [1]. SAXS became an important part of the structural biologist's toolbox and dedicated instruments are essentials to provide high quality beams and to and support the rapidly growing BioSAXS community.

Over the last decades, SAXS instruments have been developed at EMBL Hamburg [2] to allow for easy collection of the weak SAXS signal of biological macromolecules in solution, and for the proper handling and online characterisation/purification of the sample. These developments are fully implemented at the EMBL BioSAXS beamline P12 (PETRA-III ring, Hamburg). This high brilliance and low background beamline is equipped with a robotic sample changer [3] an on line size exclusion chromatography setup [4]. Data collection and analysis are highly automated, such that the first results can be obtained within a minute after data take. This automation allows mail-in/remote measurements and more than 100 user projects (for more than 300 user visits) are measured each year on this instrument.

Beyond "standard" bioSAXS measurement, P12 exploits the high flux of the X-ray beam delivered by the PETRA-III undulator for fast time resolved measurements. A recently commissioned multilayer monochromator, delivers a flux of $5x10^{14}$ photons per seconds allowing for data collection on biological samples within a ms time frame. A photon counting EIGER 4M detector is used to collect data at 750 Hz frame rate. A stopped flow device allows time resolved data collection with a dead time of a few ms. Beam chopper and laser triggering devices are now developed to further reduce the dead time of the reaction triggering and ensure a proper control of the beam in order to perform sub-ms time resolved SAXS experiments at the beamline.

References

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